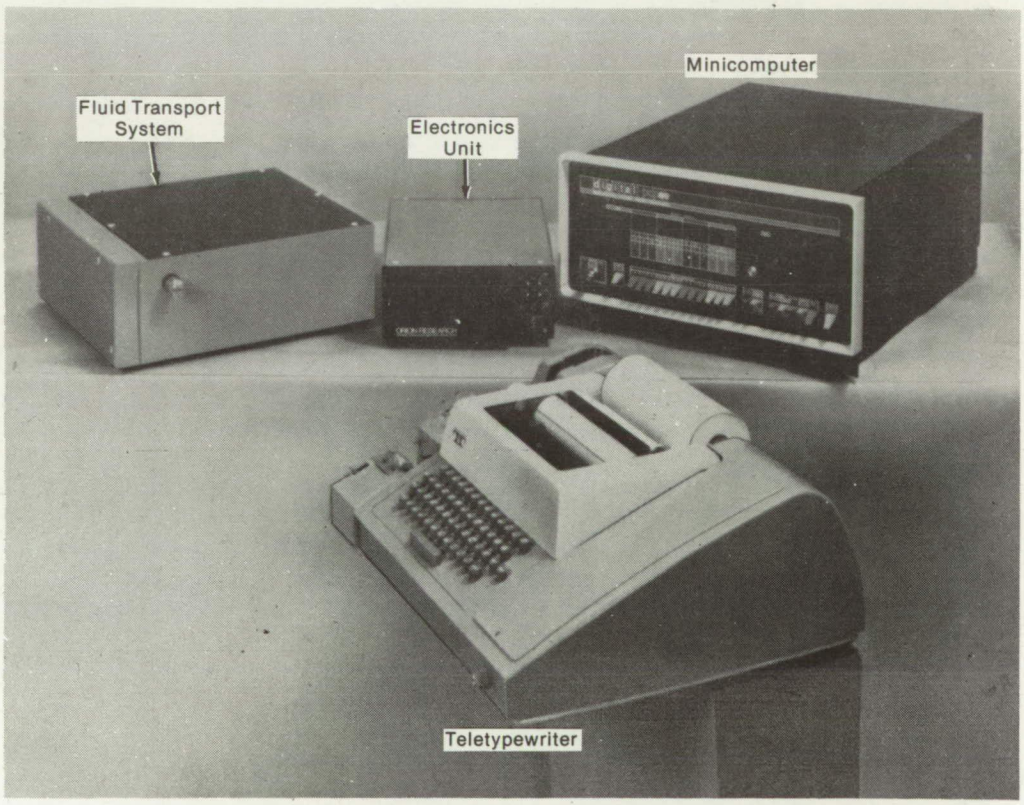
NASA TECH BRIEF

Lyndon B. Johnson Space Center

Portable Automatic Blood Analyzer

To meet the requirements of biomedical research in space, NASA's Johnson Space Center has sponsored the development of a compact and potentially-portable, automatic blood-analysis system (see figure). Automatic blood analyzers are currently being used in large hospitals that require the fast and reliable determination of blood chemistry. A commercial version of the compact system designed for the space program could make such services available on a much broader basis. The entire system occupies only a few cubic feet of space and can operate from a portable power supply.

The automatic blood analyzer employs chemical-sensing electrodes for the determination of blood gas and ion concentrations. It is rugged, easily serviced, and comparatively simple to operate. The system can analyze up to eight parameters. The design model automatically determines the levels of pH, pCO_2 (the negative log of CO_2 concentration), sodium (Na^+), chloride (Cl^-), potassium (K^+), ionized calcium (Ca^{++}), and total calcium. The system can be modified to measure other blood constituents including nonionic species, such as urea, glucose, and oxygen.



Automatic Blood Analyzer

(continued overleaf)

The system consists of four major subsystems: a fluid transport system, an electronics unit, a controller (minicomputer), and a teletypewriter. The fluid transport subsystem contains all components necessary to standardize, inject, store, deliver, measure, and dispose of test samples and reference standards. These include standard solution bags, a septum inlet port, a chromatographic switching valve, a sample-holding loop, reagent bags, electrodes, pumps, and a waste bag.

The fluid transport subsystem also includes eight amplifiers (one for each parameter), an eight-input multiplexer to select a specific amplifier output, and temperature measurement and control circuits. All of this circuitry is on a single printed-circuit board and is included in the fluid transport system because it should be kept close to the sensing electrodes. The remaining circuitry is included in the electronics unit.

The electronics unit contains most of the logic and control functions required for interface with a digital computer. Control signals from the computer are converted to the appropriate driving voltages for valves, the pump, the mixer, and the multiplexer in the fluid transfer system. The electronics unit also provides power for itself and the fluid transport system and digitizes all system-status data from the fluid transport unit to feed back to the computer.

The controller and the teletypewriter comprise the operating system. The controller is a general-purpose minicomputer with a 12-bit-word digital processor, two 4096-word memory banks, and an internal, adaptable interface system. Analyses of part or all of the system-analyzable components of a test sample may be selected in any order, and results are printed on the teletypewriter.

This rugged compact system is easy to operate because all reference solutions are automatically restandardized every sample cycle, eliminating the need for continued adjustments by the operator. In addition, all reagents and waste receptacles are contained within the system, and snap-in modules and leak-free connectors are used for convenient servicing.

Note:

This method is described in the following report:

"Automated Potentiometric Electrolyte Analysis System"

Reference: NASA CR-134373 (N74-30491).

This report may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $7.00
(or microfiche $2.25)

Patent status:

NASA has decided not to apply for a patent.

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02 (Electronics Systems)

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